

40 of FIG. 6 a catalytic layer 46 is added on top of metal layer 44 disposed on doped silicon layer 42 fabricated in a manner consistent with the teachings of the invention. The chemisorption current is measured by an integrating voltage amplifier 48. Catalytic layer 46 is chosen specifically to catalyze a selected reaction which then directly interacts with metal layer 44 to create a measurable chemicurrent. As shown diagrammatically in FIG. 7 a plurality of sensors 40 of the type shown in FIG. 6 can then be combined in an array, each one of which plurality of sensors 40 has a different catalytic layer 46 to detect a corresponding plurality of different adsorbates through x and y-addressing circuits 50 and current detector 52. In this manner an electronic nose is realized.

[0048] The words used in this specification to describe the invention and its various embodiments are to be understood not only in the sense of their commonly defined meanings, but to include by special definition in this specification structure, material or acts beyond the scope of the commonly defined meanings. Thus if an element can be understood in the context of this specification as including more than one meaning, then its use in later in a claim must be understood as being generic to all possible meanings supported by the specification and by the word itself.

[0049] The definitions of the words or elements of the following claims are, therefore, defined in this specification to include not only the combination of elements which are literally set forth, but all equivalent structure, material or acts for performing substantially the same function in substantially the same way to obtain substantially the same result. In this sense it is therefore contemplated that an equivalent substitution of two or more elements may be made for any one of the elements in later defined claims or that a single element may be substituted for two or more elements in later defined claims.

[0050] Insubstantial changes from the claimed subject matter as viewed by a person with ordinary skill in the art, now known or later devised, are expressly contemplated as being equivalently within the scope of the invention. Therefore, obvious substitutions now or later known to one with ordinary skill in the art are defined to be within the scope of the defined elements.

[0051] The invention is thus to be understood to include what is specifically illustrated and described above, what is conceptionally equivalent, what can be obviously substituted and also what essentially incorporates the essential idea of the invention.

1. An apparatus comprising:

a metal-semiconductor Schottky diode, characterized by an ultrathin metal film and Schottky barrier with current-voltage characteristics of a diode for separation of charge and the interaction of the surface adsorbates on said metal film to produce electrons or holes of sufficient energy to transverse said ultrathin metal film and cross said Schottky barrier; and

zero force electrical contacts coupled to said metal film, said zero force electrical contacts being less than 100 Angstroms thick.

2. The apparatus of claim 1 wherein said metal-semiconductor Schottky diode is formed in a wafer of silicon substrate and wherein said zero force electrical contacts

comprise two metalized contacts and a 4000 Angstrom oxide layer which are deposited using photolithographic techniques on said 4000 Angstrom oxide layer prepared on said silicon substrate.

3. The apparatus of claim 2 wherein said oxide is etched from between said contacts to expose said silicon substrate which is wet chemically treated.

4. The apparatus of claim 3 wherein said ultrathin metal is deposited under vacuum conditions onto said silicon substrate to form a diode.

5. The apparatus of claim 2 wherein said silicon substrate is microfabricated on n- or p-doped semiconductor wafers.

6. The apparatus of claim 5 wherein n-doped semiconductor wafers have $\rho_n=5-10 \Omega \text{ cm}$, and wherein p-doped semiconductor wafers have $\rho_p=1-20 \Omega \text{ cm}$, and said silicon substrate is (111) silicon.

7. The apparatus of claim 2 wherein said wafer has an upper surface on which said zero force contacts are disposed and a back on which an ohmic contact is provided by means of by As^+ and B^+ ion implantation.

8. The apparatus of claim 7 further comprising thick gold contact pads are evaporated on said 4000 angstrom thermal oxide layer and thus isolated from said silicon substrate, and a window which is chemically wet etched through said 4000 angstrom thermal oxide layer between said isolated the gold pads through the use of buffered hydrofluoric acid leaving a clean, passivated silicon surface in said window.

9. The apparatus of claim 8 further comprising metal depositions formed in an ultrahigh vacuum chamber ($p \approx 10^{-8} \text{ Pa}$).

10. The apparatus of claim 1 wherein said ultrathin film is comprised of metal films deposited by e-beam evaporation.

11. The apparatus of claim 10 wherein said ultrathin film is comprised of copper deposited at substrate temperatures of 135° K .

12. The apparatus of claim 10 wherein said ultrathin film is comprised of silver deposited at substrate temperatures of 135° K .

13. The apparatus of claim 10 wherein said ultrathin film is comprised of iron.

14. The apparatus of 7 wherein said oxide is etched from between said contacts to expose said silicon substrate which is wet chemically treated and wherein said etched oxide produces an angle of inclination between the oxide and a top surface of said silicon substrate, said evaporated thin metal films being connected to said thick gold pads across said angle of inclination to provide said zero force contact to allow electrical contact for the current/voltage measurements between front and back contacts on said silicon substrate even with metal film thicknesses below 80 angstroms.

15. A method associated with chemisorption of atomic hydrogen or atomic deuterium on Ag and Cu ultrathin films comprising:

providing Ag and Cu ultrathin films deposited onto a silicon surface in a Schottky diode detector;

generating an incident atomic H or D beam; and

generating a current associated with said incident atomic H or D beam on said Ag and Cu ultrathin films so that a chemicurrent results from chemisorption of induced excited charge carriers which traverse a Schottky barrier in said Schottky diode detector.